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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/837,911	04/18/2001	Hui Wang	495152000111	9922

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EXAMINER	
LEADER, WILLIAM T	
ART UNIT	PAPER NUMBER
1742	

DATE MAILED: 03/25/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	09/837,911	WANG, HUI	
	Examiner	Art Unit	
	William T. Leader	1742	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *06 January 2005*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *110-159* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *110-159* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

1. Receipt of the papers filed on January 6, 2005, is acknowledged.

2. Applicant's Remarks with respect to the Woodruff patent are persuasive. The rejections of record based on Woodruff are withdrawn.

3. The text of those sections of Title 35, U.S. Code not included in this action can be found in a prior Office action.

Claim Rejections - 35 USC § 112

4. The following is a quotation of the second paragraph of 35 U.S.C. 112:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

5. Claims 113-118 and 131-159 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

6. Independent claims 113 and 142 are directed to apparatus. As written, the scope of the apparatus is dependent on the structure of the workpiece processed by the apparatus. However, the material or article worked upon does not properly limit apparatus claims. See MPEP 2115. Claims 113 and 124 recite a plating bath divided by a first wall and at least a second wall, wherein the first wall is adjacent to a first portion of the substrate and the at least second wall is adjacent to at least a second portion of the substrate when the substrate is positioned within the bath.

This limitation could be met when using the apparatus to process a substrate having one configuration or size, but not by a substrate having a different configuration or size. For example, a large workpiece could be sufficiently wide to extend across the apparatus so as to have first and second portion adjacent two walls of the substrate. But, a smaller workpiece might extend only partially across the apparatus and be adjacent to only a first wall of the apparatus. This creates a situation in which the apparatus would meet the claim limitation with one size workpiece, but not a different size workpiece. Additionally, claims 113 and 124 recite that the first portion and the second portion are portions of the same surface on the substrate. This relates that structure of the claimed apparatus to the geometry of the substrate. The workpiece could be a semiconductor wafer which has two opposed planar surfaces. However, the workpiece could be cylindrical tube which has an outer surface and inner surface. The apparatus could have a structure in which first and second walls were adjacent first and second portions of a planar wafer, but not adjacent to the inner and outer surfaces of a cylinder. Again, the structure of the apparatus would meet the claim limitation with one workpiece, but not the other. Because of the reliance of the structure of the claimed apparatus on the substrate to be processed, the claims are considered to be indefinite.

7. Applicant's Remarks and the amendments to the claims have been considered but are not deemed to be persuasive. Applicant argues that independent claims 113 and 142 have been amended to recite that the substrate is a semiconductor wafer and that semiconductor wafers of standard sizes are used in the semiconductor industry. This argument is not convincing. The recited apparatus is not limited to processing wafers of any particular size.

Claim Rejections - 35 USC § 103

8. Claims 110, 113, 115, 116, 118, 119, 122, 123, 126, 127, 129-131, 137, 141-143, 145, 150, 153 and 154 are rejected under 35 U.S.C. 103(a) as being unpatentable over Fairbairn et al (6,176,667) in view of Japanese patent publication 04-311591 A to Hirohiko (hereinafter Hirohiko).

9. The Fairbairn et al patent is directed to a wafer processing system. Fairbairn et al disclose that floor space in a clean room used for fabricating semiconductor devices is expensive. The per-square-foot construction cost, as well as maintenance cost, is high (column 1, lines 28-30). To reduce the amount of floor space required, thereby lowering capital cost per wafer processed, Fairbairn et al propose stacking processing chambers (modules) one above another vertically (column 1, lines 50-55). As shown in figure 1, wafers are removed from wafer cassette 12 by robot arm 32 and loaded into processing chambers A1 and A2. While

figure 1 shows two stacked chambers, Fairbairn et al teach that as many as desired may be stacked vertically (column 3, lines 17-18). Any suitable semiconductor operation can be performed in the chambers (column 3, lines 28-30). As examples, Fairbairn et al list a number of plating processes (column 3, lines 30-31). Figure 3 shows means for supplying cleaning gas to the process chambers.

10. Independent method claim 110 differs from the process and apparatus of Fairbairn et al by reciting positioning the substrate within a bath in a first stacked plating module, the bath divided by a first wall and at least a second wall. Independent apparatus claims 113 and 142 include similar limitations. Hirohiko is directed to a process and apparatus for electroplating onto a wafer. As shown in figure 1, a reactor that includes vessel 11 which holds an electroplating bath is provided. This corresponds to the bath of applicant's claims. The apparatus utilizes an anode array 4 comprising a plurality of concentric anode segments. See figure 1. As shown in figures 1 and 2, the anode segments are located between concentric spacers or walls 121. These walls divide the vessel and correspond to the walls recited by applicant. As shown in figure 1, a workpiece W, which may be a wafer, is positioned such that it is in generally confronting relationship to the anode array and walls 121. With a substrate of this configuration, a first wall is adjacent to a first portion of the substrate while a second wall is adjacent to a second portion of the substrate as recited in claims 110, 113 and 142. The apparatus of Hirohiko

promotes uniformity of deposition of electroplated metal onto the workpiece (abstract).

11. The prior art of record is indicative of the level of skill of one of ordinary skill in the art. It would have been obvious to have utilized the electroplating vessel disclosed by Hirohiko as one or more of the plating chambers in the apparatus of Fairbairn et al because desirable uniform metal deposits would have been formed on the semiconductor wafers being processed.

12. With respect to claim 115, Fairbairn et al shows in figures 1 and 2 that robot arm 32 is movable in the X-Y plane and is capable of telescoping to position the wafers in the processing chambers. Fairbairn et al disclose that the robot arm is lifted to pick up the wafers from the cassette (column 3, lines 48-51). This movement is in the Z direction, showing that the arm can move with three degrees of freedom.

13. With respect to claim 116, Figure 1 of Fairbairn et al suggests that the robot actuator 33 which moves arm 32 is mounted on a bottom portion of the frame. The provision of a second set of plating baths and cleaning modules as recited in claim 118 is suggested by figure 2 of Fairbairn et al which shows a plurality of sets of stacked processing modules.

14. Method claim 119, as well as similar apparatus claims 135 and 158, recite flowing electrolyte in the gaps between the first and second walls at the first and

second portions of the substrate, respectively. As shown in figure 1 of Hirohiko, and described in the abstract, the workpiece, such as a semiconductor wafer, is positioned in confronting relationship with the anode array and walls 121. Gaps are formed between corresponding portions of the wafer and each element of the anode array each wall 121. Hirohiko further discloses that the plating solution is supplied from the space 122 in the inner vessel 12 and cylindrical spaces 123. Thus, the electrolyte will flow across the surface of the wafer and through the gaps between walls 121 and corresponding portions of the wafer as recited in claims 119, 135 and 158. See figure 5.

15. With respect to claims 122, 123, 130, 131, 153 and 154, Hirohiko disclose the use of concentric anode segments 4. The anodes are adjacent to the walls as shown in figure 1. Hirohiko discloses that rotary electrode 3 is a cathode electrode while elements 4 are anode electrodes. For electrodes to have been cathodic and anodic, a power supply connected to the electrodes would have been necessary.

16. With respect to claims 126, 139 and 145, Fairbairn et al teach that each of the processing chambers is adapted to carry out a specific semiconductor processing operation and mentions coating and etching operations as examples (column 3, lines 20-37). The use of different hardware and chemicals to perform a variety of different semiconductor processing operations would have been obvious in view of the teaching of Fairbairn et al.

17. With respect to claims 127, 137 and 143, Hirohiko teaches that the wafer is held on a rotary cathode electrode (abstract).

18. With respect to claims 129 and 141 the robot arm of Fairbairn et al is adapted to move in the X-Y plane which corresponds to a horizontal direction.

19. Claims 111, 112, 114, 124, 125, 138, 139, 144 and 146-149 are rejected under 35 U.S.C. 103(a) as being unpatentable over Fairbairn et al (6,176,667) in view of Hirohiko (Jp 04-311591) as applied to claims 110, 113, 115, 116, 118, 119, 122, 123, 126, 127, 129-131, 137, 141-143, 145, 150, 153 and 154 above, and further in view of Dubin et al (5,882,498).

20. Claims 111 differs from the process suggested by Fairbairn et al and Hirohiko by reciting drying the substrate by at least one of spinning the substrate of directing drying gas onto the substrate. The Dubin et al patent is directed to the production of semiconductor wafers. During the production of the wafers a number of processes are carried out. These include a step of electroplating and a spin/rinse/dry step. Dubin et al disclose that after a metal layer is formed during the electroplating process, the silicon substrate is removed from the electrolyte solution and transferred to another process chamber such as a spin/rinse/dry chamber (column 1, lines 56-60). It would have been obvious at the time the invention was made to have cleaned and dried the substrate after electroplating in

the process suggested by Fairbairn et al and Hirohiko as taught by Dubin et al because electrolyte from the electroplating step would have been removed. With respect to claims 112 and 146, Fairbairn et al teaches the provision of chambers to carry out a variety of semiconductor process steps and movement between chambers by the transfer arm. With respect to claims 114, 147 and 148, Fairbairn et al disclose that as many chambers may be stacked vertically as desired (column 3, lines 14-17). Provision of more than one cleaning chamber would have been obvious because throughput would have been increased. Claim 149 is directed to apparatus but written using process language. The apparatus suggested by Fairbairn et al, Hirohiko and Dubin et al would have been capable of being operated in the manner recited by claim 149.

21. With respect to claims 124, 125, 138, 139 and 144, Dubin et al discloses that typically a barrier and a seed layer of metal is deposited on the silicon substrate prior to placement of the substrate in the electroplating process chamber (column 1, lines 19-21). It would have been obvious at the time the invention was made to have provided a chamber in the apparatus of Fairbairn et al to have formed a seed layer and to have transferred a wafer from the seed layer chamber to the electroplating chamber because the wafer surface would have been made conductive to allow electroplating as taught by Dubin et al.

22. Claim 117 is rejected under 35 U.S.C. 103(a) as being unpatentable over Fairbairn et al (6,176,667) in view of Hirohiko (Jp 04-311591) as applied to claims 110, 113, 115, 116, 118, 119, 122, 123, 126, 127, 129-131, 137, 141-143, 145, 150, 153 and 154 above, and further in view of Davis (6,477,440).

23. Claim 117 recites that the transferring mechanism is mounted on a top portion of the frame. As noted above, in Fairbairn et al the transferring mechanism is mounted on a bottom portion of the frame. The Davis patent is directed to a method and apparatus for treating semiconductor wafers. A plurality of stacked chambers is provided. Transfer mechanism 52 is mounted on a shelf toward the upper portion of the frame. It would have been obvious at the time the invention was made to have mounted the transfer mechanism of a semiconductor processing apparatus in any position, such as a top portion of the apparatus frame as in Davis, from which the wafers could be transported to the various loading and processing chambers.

24. Claims 128 and 140 are rejected under 35 U.S.C. 103(a) as being unpatentable over Fairbairn et al (6,176,667) in view of Hirohiko (Jp 04-311-591) as applied to claims 110, 113, 115, 116, 118, 119, 122, 123, 126, 127, 129-131, 137, 141-143, 145, 153 and 154 above, and further in view of Kobayashi et al (5,925,227).

25. Claims 128 and, 140 relate to movement of the substrate. As previously noted, Fairbairn et al discloses robot arm 32 to move the substrate. This arm is capable of moving the substrate in a horizontal plane and in a vertical direction as well. Claims 128 and 140 recite moving the substrate holder in a vertical direction. The Kobayashi et al patent is directed to apparatus for processing semiconductor wafers. The apparatus includes a transfer arm which is capable of moving in a vertical direction as shown in figure 2. Figure 3 shows substrate support members 521 which are also capable of moving in a vertical direction. It would have been obvious to have included means for moving the substrate vertically in the apparatus of Fairbairn et al as shown by Kobayashi et al to have facilitated transfer between the stacked chambers.

26. Claims 132 and 155 are rejected under 35 U.S.C. 103(a) as being unpatentable over Fairbairn et al (6,176,667) in view of Hirohiko (Jp 04-311-591) as applied to claims 110, 113, 115, 116, 118, 119, 122, 123, 126, 127, 129-131, 137, 141-143, 145, 150, 153 and 154 above, and further in view of above, and further in view of Van Raalte et al (3,880,725) or Kubo et al (5,326,455).

27. Claims 132 and 155 differ by reciting a fist power supply connected to the first anode and at least a second power supply connected to at least the second anode. Both Van Raalte et al and Kubo et al disclose the independent control of

each of a plurality of counter electrodes in an electroplating process to provide improved control of the thickness profile of the deposited metal. See column 3, line 62 to column 4, line 11 of Van Raalte et al and the abstract of Kubo et al. It would have been obvious to have provided separate power supplies for the anode segments 4 of Hirohiko as taught by Van Raalte et al and Kubo et al because improved control of the thickness distribution of the plated metal would have been obtained.

28. Claims 151 and 152 are rejected under 35 U.S.C. 103(a) as being unpatentable over Fairbairn et al (6,176,667) in view of Hirohiko (Jp 04-311-591) and Dubin et al (5,882,498) as applied to claims 111, 112, 114, 124, 125, 138, 139, 144 and 146-149 above, and further in view of Kobayashi et al.

Claims 151 and 152 recite limitations similar to claims 128 and 140 discussed in the previous paragraph. It would have been obvious to have included means for moving the substrate vertically in the apparatus of Fairbairn et al as shown by Kobayashi et al to have facilitated transfer between the stacked chambers.

29. Claims 120, 121, 133-135, 156-158 are rejected under 35 U.S.C. 103(a) as being unpatentable over Fairbairn et al (6,176,667) in view of Hirohiko (Jp 04-311-591) as applied to claims 110, 113, 115, 116, 118, 119, 122, 123, 126, 127, 129-131,

137, 141-143, 145, 150, 153 and 154 above, and further in view of Andricacos et al (5,522,975).

30. Claims 120, 121, 133-135 and 156-158 recite the inclusion of a plumbing box and that the box includes a pump, valves, filters and plumbing connections.

31. Hirohiko shows that the electroplating solution is circulated (figure 1, abstract) but does not provide details of the equipment used to accomplish the circulation. The Andricacos et al is directed to electroplating onto an article such as a wafer immersed in an electrolyte bath. Andricacos et al disclose a circulation system for circulation the electrolyte. As shown in figure 2, the system includes a pump, filter, valves and interconnecting plumbing (column 3, lines 32-35). These are the same elements recited in claims 121, 134 and157. It would have been obvious to have accomplished circulation of the electrolyte in the method and apparatus suggested by Fairbairn et al and Hirohiko using a system including a pump, valves, filters and plumbing connections because Andricacos et al shows these components to be suitable for circulating an electroplating electrolyte. As noted above, the limitations of claims 135 and 158 are suggested by Hirohiko.

32. Claims 136 and 159 are rejected under 35 U.S.C. 103(a) as being unpatentable over Fairbairn et al (6,176,667) in view of Hirohiko (Ph 04-311591) in

view of Andricacos et al (5,522,975) as applied to claims 120, 121, 133-135 and 156-158 above, and further in view of the Electroplating Engineering Handbook.

33. Claims 136 and 159 additionally recite a temperature control. Chapter 22 of the Handbook is directed to heating and cooling equipment for use in electroplating apparatus. It would have been obvious to have provided a temperature control as recited in claims 136 and 159 because the Handbook shows temperature control equipment to be conventional and because optimum performance during electroplating would have been obtained by controlling temperature.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to William T. Leader whose telephone number is 571-272-1245. The examiner can normally be reached on Mondays-Thursdays and alternate Fridays, 7:30-4:00.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Roy King, can be reached on 571-272-1244. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

William Leader
March 18, 2005

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